Prelexically-driven perceptual retuning of phoneme boundaries

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Abstract

Listeners heard an ambiguous /f-s/ in nonword contexts where only one of /f/ or /s/ was legal (e.g., *frul/*srul or *fnud/snud*). In later categorisation of a phonetic continuum from /f/ to /s/, their category boundaries had shifted; hearing *-rul* led to expanded /f/ categories, *-nud* expanded /s/. Thus phonotactic sequence information alone induces perceptual retuning of phoneme category boundaries; lexical access is not required.
Index Terms: phoneme boundaries, learning, phonotactics

1. Introduction

Exposure to just 10-20 instances of a deviant form of a given phoneme produces perceptual learning about the speaker's pronunciation of that phoneme, as long as the deviant sound is heard in real-word contexts so that it can be identified [1]; thus an ambiguous sound between /s/ and /f/ will be learned as /s/ if heard in words like *horse*, as /f/ if heard in words like *giraffe*, but not affected if heard in nonwords such as *liff/liss*. This learning generalises to other words containing the same phoneme [2]. Analogous retuning occurs for other categories, even colours [3], suggesting the involvement of a powerful, general learning mechanism for retuning perceptual category decisions by reference to meaningful knowledge.

Although nonwords have not produced retuning in earlier studies, we reasoned that phonotactic sequencing constraints should form part of listeners' abstract knowledge about their language, and that phonotactics should thus serve to retune category decisions even if embedded in non-lexical contexts.

2. Perceptual learning experiment

2.1. Stimuli

A sound ambiguous between /f/ and /s/ ([f/s]) was chosen in a pretest with a 41-step continuum. 20 matched nonword pairs were devised, e.g., *frul*/*snud*. With 100 words and 60 more nonwords (all without /f/ or /s/), these made up two 200-item lexical decision lists. In List A, nonwords with /r/ clusters had a natural /f/, nonwords with /n/ clusters contained the [f/s]; in List B, /n/ nonwords had a natural /s/, /r/ nonwords had [f/s].

From the pretest continuum, which ranged from *flar* to *slar*, five steps were chosen, corresponding approximately to 5%, 20%, 50%, 80% and 95% /f/ responses in the pretest. A phonetic categorisation experiment was constructed with 18 instances of each of these five tokens, in pseudo-random order.

2.2. Participants and procedure

48 British English speakers in Cambridge (U.K.) took part. In Part I (lexical decision) they heard 200 words and nonwords and decided for each item whether it was a real English word. 24 subjects heard List A, 24 B. In Part II all subjects heard 90 syllables and judged for each one whether it was *flar* or *slar*.

2.3. Results and Discussion

In lexical decision, nonwords were correctly rejected. Figure 1 shows the results of the categorisation experiment. Listeners who had heard List A ([f/s] = /s/) made more /s/ responses, while List B listeners ([f/s] = /f/) made more /f/ responses. Statistical analysis focussed on the most ambiguous step of the fricative continuum. List B listeners labelled this sound more often as /f/ than /s/: $F(1,46) = 4.34$, $p<.05$.

As in [1], our listeners were unaware of the connection between the tasks (lexical decision, categorisation). Yet they altered their decisions in the latter as a result of experience with the speaker's output in the former. None of the words in the lexical task contained /f/ or /s/; these sounds occurred only in the critical nonwords. No lexical information can indicate what an ambiguous sound in a nonword is supposed to be; the phonotactic legality of the initial clusters in these nonwords however sufficed to identify them. If the ambiguous sound was heard with /n/, it was perceived as /s/ (*snud*), but with /r/ as /f/ (*frul*). Retuning of listeners' /f/-/s/ boundary resulted, affecting not just the most ambiguous point but the whole continuum.

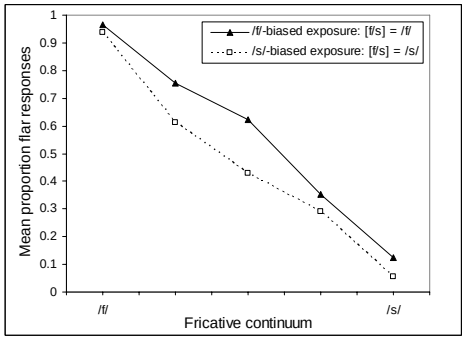

Figure 1: *Proportion of* flar *responses on a 5-step* flar-slar *continuum, as a function of biasing exposure in preceding lexical decision experiment nonwords.*

3. Conclusions

Listeners possess abstract knowledge about the permissible sequencing of phonemes in words of the native language. This knowledge can be referred to when ambiguous nonwords are encountered, to direct interpretation of the nonwords (*frul* not **srul*, *snud* not **fnud*). The interpretation can then be used to retune phoneme category boundaries in neutral environments.

4. References

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